What is claimed is:

1. An optical pickup device, comprising:

a first light source to emit a first light flux having a wavelength $\lambda 1$ (380 nm < $\lambda 1$ < 450 nm);

a second light source to emit a second light flux having a wavelength $\lambda 2$ (600 nm < $\lambda 2$ < 700 nm); and

a light-converging optical system having a light-converging optical element including a diffractive structure and a correcting element arranged between the first light source and/or the second light source and the light-converging optical element;

wherein the light-converging optical system converges the first light flux emitted from the first light source on an information recording surface of a first optical information recording medium through a protective layer having a thickness t1 so that the optical pickup device conducts recording and/or reproducing information for the first information recording medium and the light-converging optical system converges the second light flux emitted from the second light source on an information recording surface of a second optical information recording medium through a

protective layer having a thickness t2 so that the optical pickup device conducts recording and/or reproducing information for the second information recording medium,

wherein the light-converging optical system forms a first spot on the information recording surface of the first optical information recording medium by using N-th order diffracted light ray generated when the first light flux from the first light source passes through the diffractive structure of the light-converging optical system, and the light-converging optical system forms a second spot on the information recording surface of the second optical information recording medium by using M-th order ($M \neq N$) diffracted light ray generated when the second light flux from the second light source passes through the diffractive structure of the light-converging optical system, and

wherein on the first spot formed on the information recording surface of the first optical information recording medium, a deteriorated spherical aberration due to a wavelength change in the first light source and a deteriorated spherical aberration due to a temperature change are regulated to be within a range necessary for recording and/or reproducing of information, and on the second spot

formed on the information recording surface of the second optical information recording medium, a deteriorated spherical aberration due to a wavelength change in the second light source and a deteriorated spherical aberration due to a temperature change are regulated to be within a range necessary for recording and/or reproducing of information.

2. The optical pickup device of claim 1, wherein on the first spot formed on an information recording surface of the first optical information recording medium, a chromatic aberration of the converged spot caused by a change in a wavelength of a light source is regulated to be within a range necessary for recording and/reproducing of information, and on the second spot formed on an information recording surface of the second optical information recording medium, a chromatic aberration of the converged spot caused by a change in a wavelength of a light source is regulated to be within a range necessary for recording and/reproducing of information.

3. The optical pickup device of claim 1, wherein t1 representing a thickness of a protective layer of the first optical information recording medium and t2 representing a thickness of a protective layer of the second optical

information recording medium satisfy the following expressions.

$0.5\ mm \leq t1 \leq 0.7\ mm$

$0.5\ mm \leq t2 \leq 0.7\ mm$

4. The optical pickup device of claim 1, wherein the diffractive structure is provided on a area on a part of at least one optical surface of the light converging optical element through which both of the first and second light fluxes commonly pass when conducting recording and/or reproducing of information for the first and second optical information recording mediums, a diffraction efficiency of 3m-th (m represents a positive integer) order diffracted light ray becomes higher than a diffraction efficiency of any one of other order diffracted light rays generated when the first light flux emitted from the first light source passes through the diffractive structure, and a diffraction efficiency of 2m-th order diffracted light becomes higher than a diffraction efficiency of any one of other order diffracted light rays generated when the second light flux emitted from the second light source passes through the diffractive structure.

5. The optical pickup device of claim 1, wherein the diffractive structure is provided on a area on a part of at least one optical surface of the light converging optical element through which both of the first and second light fluxes commonly pass when conducting recording and/or reproducing of information for the first and second optical information recording mediums, a diffraction efficiency of 8p-th (p represents a positive integer) order diffracted light ray becomes higher than a diffraction efficiency of any one of other order diffracted light rays generated when the first light flux emitted from the first light source passes through the diffractive structure, and a diffraction efficiency of 5p-th order diffracted light becomes higher than a diffraction efficiency of any one of other order diffracted light rays generated when the second light flux emitted from the second light source passes through the diffractive structure.

6. The optical pickup device of claim 1, wherein the diffractive structure is provided on a area on a part of at least one optical surface of the light converging optical element through which both of the first and second light fluxes commonly pass when conducting recording and/or

reproducing of information for the first and second optical information recording mediums, a diffraction efficiency of 2n-th (n represents a positive integer) order diffracted light ray becomes higher than a diffraction efficiency of any one of other order diffracted light rays generated when the first light flux emitted from the first light source passes through the diffractive structure, and a diffraction efficiency of n-th order diffracted light becomes higher than a diffraction efficiency of any one of other order diffracted light rays generated when the second light flux emitted from the second light source passes through the diffractive structure.

7. The optical pickup device of claim 1, wherein the correcting element is arranged in an optical path through which only the first light flux emitted from the first light source passes, or arranged in an optical path through which only the second light flux emitted from the second light source passes.

8. The optical pickup device of claim 7, wherein the correcting element is arranged in an optical path through which only the second light flux emitted from the second

light source passes, and wherein on the first spot formed on an information recording surface of the first optical information recording medium, a chromatic aberration of the converged spot caused by a change in a wavelength of a light source is regulated by the light converging optical element so as to be within a range necessary for recording and/reproducing of information, and on the second spot formed on an information recording surface of the second optical information recording medium, a chromatic aberration of the converged spot caused by a change in a wavelength of a light source is regulated by the correcting element so as to be within a range necessary for recording and/reproducing of information.

9. The optical pickup device of claim 8, wherein on the diffractive structure provided on the light-converging optical element, the number N1 of diffractive ring-shaped zones existing on the area where both of the first and second light fluxes commonly pass when conducting recording and/or reproducing of information for the first and second optical information recording mediums satisfies the following formula;

$$115/A \leq N1 \leq 155/A$$

where A is 3m or 8p and is a order of diffracted light ray whose diffraction efficiency is higher than that of any one of other order diffracted light rays of the first light flux having a wavelength $\lambda 1$.

10. The optical pickup device of claim 8, wherein the correcting element comprises a diffractive structure on at least one optical surface thereof and the number N2 of diffractive ring-shaped zones existing on the diffractive structure of the correcting element satisfies the following formula;

$$15/k \leq N2 \leq 45/k$$

where k is an order of diffracted light ray whose diffraction efficiency is higher than that of any one of other order diffracted light rays of the second light flux having a wavelength $\lambda 2$.

11. The optical pickup device of claim 7, wherein a sign of a diffracting power of the diffractive structure of the correcting element is positive.

12. The optical pickup device of claim 7, wherein the correcting element is arranged in an optical path through which only the first light flux emitted from the first light source passes, and wherein on the first spot formed on an information recording surface of the first optical information recording medium, a chromatic aberration of the converged spot caused by a change in a wavelength of a light source is regulated by the correcting element so as to be within a range necessary for recording and/reproducing of information, and on the second spot formed on an information recording surface of the second optical information recording medium, a chromatic aberration of the converged spot caused by a change in a wavelength of a light source is regulated by the light converging optical element so as to be within a range necessary for recording and/reproducing of information.

13. The optical pickup device of claim 12, wherein on the diffractive structure provided on the light-converging optical element, the number N1 of diffractive ring-shaped zones existing on the area where both of the first and second light fluxes commonly pass when conducting recording and/or reproducing of information for the first and second optical

information recording mediums satisfies the following formula;

$$45/A \leq N1 \leq 65/A$$

where A is 3m or 8p and is a order of diffracted light ray whose diffraction efficiency is higher than that of any one of other order diffracted light rays of the first light flux having a wavelength $\lambda 1$.

14. The optical pickup device of claim 12, wherein the correcting element comprises a diffractive structure on at least one optical surface thereof and the number N2 of diffractive ring-shaped zones existing on the diffractive structure of the correcting element satisfies the following formula;

$$30/k \leq N2 \leq 80/k$$

where k is an order of diffracted light ray whose diffraction efficiency is higher than that of any one of other order diffracted light rays of the second light flux having a wavelength $\lambda 2$.

15. The optical pickup device of claim 12, wherein a sign of a diffracting power of the diffractive structure of the correcting element is negative.

16. The optical pickup device of claim 1, wherein the correcting element is arranged in an optical path through which the first light flux emitted from the first light source passes and in an optical path through which the second light flux emitted from the second light source passes.

17. The optical pickup device of claim 16, wherein on the first spot formed on an information recording surface of the first optical information recording medium and on the first spot formed on an information recording surface of the first optical information recording medium, a chromatic aberration of the converged spot caused by a change in a wavelength of a light source is regulated by the light converging optical element so as to be within a range necessary for recording and/reproducing of information, and on the first spot formed on an information recording surface of the first optical information recording medium and on the first spot formed on an information recording surface of the first optical information recording medium, a deteriorated spherical

aberration due to a change in temperature is regulated by the correcting element so as to be within a range necessary for recording and/reproducing of information.

18. The optical pickup device of claim 17, wherein on the diffractive structure provided on the light-converging optical element, the number N1 of diffractive ring-shaped zones existing on the area where both of the first and second light fluxes commonly pass when conducting recording and/or reproducing of information for the first and second optical information recording mediums satisfies the following formula;

$$144/(2n) \leq N1 \leq 176/(2n)$$

where 2n is an order of diffracted light ray whose diffraction efficiency is higher than that of any one of other order diffracted light rays of the first light flux having a wavelength $\lambda 1$.

19. The optical pickup device of claim 17, wherein the correcting element comprises a diffractive structure on at least one optical surface thereof and the number N2 of diffractive ring-shaped zones existing on the diffractive

structure of the correcting element satisfies the following formula;

$$30/k \leq N2 \leq 80/k$$

where k is an order of diffracted light ray whose diffraction efficiency is higher than that of any one of other order diffracted light rays of the second light flux having a wavelength $\lambda 2$.

20. The optical pickup device of claim 12, wherein a sign of a diffracting power of the diffractive structure of the correcting element is positive.

21. The optical pickup device of claim 1, wherein a focal length f1 of the light converging optical element for the first light flux from the first light source satisfies the following formula:

$$1.8 \text{ mm} \leq f1 \leq 3.0 \text{ mm}$$

22. The optical pickup device of claim 1, wherein a magnification mt of an optical system in which the light converging optical element and the correcting element are combined satisfies the following formula:

$$-1/3 \leq mt \leq -1/10$$

23. The optical pickup device of claim 1, wherein regulating a deteriorated spherical aberration due to a wavelength change in a light source within a range necessary for recording and/or reproducing of information means that when a light source wavelength λ changes by 10 nm, a spherical aberration change amount of a wavefront aberration is regulated to be 0.065 λrms or less.

24. The optical pickup device of claim 1, wherein regulating a chromatic aberration on a converged spot due to a wavelength change in a light source within a range necessary for recording and/or reproducing of information means that when a light source wavelength λ changes by 1 nm, a wavefront aberration at a best image forming position before the wavelength change is regulated to be 0.02 λrms or less.

25. The optical pickup device of claim 1, wherein regulating a deteriorated spherical aberration due to a temperature change within a range necessary for recording and/or reproducing of information means that when a

temperature changes by 30°C, a spherical aberration change amount of a wavefront aberration is regulated to be 0.04 λrms or less.

26. The optical pickup device of claim 1, wherein the following expression is satisfied when NA1 represents an image side numerical aperture of the light-converging optical element necessary for conducting recording and/or reproducing of information for the first optical information recording medium.

$$0.63 \leq NA1 \leq 0.67$$

27. The optical pickup device of claim 1, wherein the following expression is satisfied when NA2 represents an image side numerical aperture of the light-converging optical element necessary for conducting recording and/or reproducing of information for the second optical information recording medium.

$$0.63 \leq NA2 \leq 0.67$$

28. The optical pickup device of claim 1, wherein the following expression is satisfied when $\Delta\lambda 1/\Delta T$ represents

fluctuations of a wavelength of the first light source for temperature.

$$0.03\ \text{nm} \leq \Delta\lambda1/\Delta T \leq 0.1\ \text{nm}$$

29. The optical pickup device of claim 1, wherein the following expression is satisfied when $\Delta\lambda1/\Delta T$ represents fluctuations of a wavelength of the second light source for temperature.

$$0.15\ \text{nm} \leq \Delta\lambda2/\Delta T \leq 0.25\ \text{nm}$$

30. The optical pickup device of claim 1, further comprising:

a third light source to emit a third light flux having a wavelength $\lambda3$ (750 nm < $\lambda3$ < 800 nm),

wherein the light-converging optical system converges a divergent light flux emitted from the third light source on an information recording surface of the third optical information recording medium through a protective layer having a thickness t3 so that the optical pickup device conducts recording and/or reproducing information for a third information recording medium.

31. The optical pickup device of claim 30, wherein a optical system magnification mo of the light converging optical element for a incident light flux having a wavelength $\lambda 3$ satisfies the following formula:

$$-1/12 < mo < -1/14$$

32. The optical pickup device of claim 30, wherein a diffraction efficiency of (3m/2)-th ((3m/2) represents an integer) order diffracted light ray becomes higher than a diffraction efficiency of any one of other order diffracted light rays generated when the third light flux emitted from the third light source passes through.

33. The optical pickup device of claim 30, wherein a diffraction efficiency of 4p-th order diffracted light ray becomes higher than a diffraction efficiency of any one of other order diffracted light rays generated when the third light flux emitted from the third light source passes through.

34. The optical pickup device of claim 30, wherein a diffraction efficiency of n-th order diffracted light ray becomes higher than a diffraction efficiency of any one of

other order diffracted light rays generated when the third light flux emitted from the third light source passes through.

35. The optical pickup device of claim 34, wherein the second light source and the third light source are arranged at a position where a distance on an optical axis from the light converging optical element is made equal.

36. The optical pickup device of claim 36, further comprising:

a coupling lens provided in a optical path on which only the third light flux from the third light source passes and to change a divergent angle or a convergent angle of the third light flux from the third light source.

37. An optical pickup apparatus, comprising:

a first light source to emit a first light flux having a wavelength $\lambda 1$ (380 nm < $\lambda 1$ < 450 nm); and

a light-converging optical system having a light-converging optical element including a diffractive structure and a correcting element arranged between the first light source and the light-converging optical element;

wherein the light-converging optical system converges the first light flux emitted from the first light source on an information recording surface of a first optical information recording medium through a protective layer having a thickness t1 so that the optical pickup device conducts recording and/or reproducing information for the first information recording medium, and

wherein on a first spot formed on the information recording surface of the first optical information recording medium, a deteriorated spherical aberration due to a wavelength change in the first light source and a deteriorated spherical aberration due to a temperature change are regulated to be within a range necessary for recording and/or reproducing of information.

38. The optical pickup device of claim 37, wherein a diffractive structure is provided on a area on a part of at least one optical surface of the light converging optical element, and when the order of a diffracted ray whose diffraction efficiency is the largest among other order diffracted light rays generated when the first light flux emitted from the first light source passes through the diffractive structure of the light converging optical element

is K_{BOL} and the number of ring-shaped zones of the diffractive structure of the light converging element is n_{BOL}, the following formula is satisfied:

$$30 < n_{BOL} \cdot K_{BOL} < 130$$

39. The optical pickup device of claim 37, wherein a diffractive structure is provided on a area on a part of at least one optical surface of the correcting element, and when the order of a diffracted ray whose diffraction efficiency is the largest among other order diffracted light rays generated when the first light flux emitted from the first light source passes through the diffractive structure of the correcting element is K_{COL} and the number of ring-shaped zones of the diffractive structure of the light converging element is n_{COL}, the following formula is satisfied:

$$30 < n_{COL} \cdot K_{COL} < 130$$

40. The optical pickup device of claim 37, wherein on the first spot formed on the information recording surface of the first optical information recording medium, a chromatic aberration of the converged spot caused by a change in a

wavelength of a light source is regulated to be within a range necessary for recording and/reproducing of information.

41. The optical pickup device of claim 37, wherein the thickness t1 of the protective layer of the first optical information recording medium satisfies the following formula:

$$0.5 \text{ mm} \leq t1 \leq 0.7 \text{ mm}$$

42. The optical pickup device of claim 37, wherein a focal length f1 of the light converging optical element for the first light flux from the first light source satisfies the following formula:

$$1.8 \text{ mm} \leq f1 \leq 3.0 \text{ mm}$$

43. The optical pickup device of claim 37, wherein a magnification mt of an optical system in which the light converging optical element and the correcting element are combined satisfies the following formula:

$$-1/3 \leq mt \leq -1/10$$

44. The optical pickup device of claim 37, wherein regulating a deteriorated spherical aberration due to a wavelength change in a light source within a range necessary

for recording and/or reproducing of information means that when a light source wavelength λ changes by 10 nm, a spherical aberration change amount of a wavefront aberration is regulated to be 0.07 λrms or less.

45. The optical pickup device of claim 37, wherein regulating a chromatic aberration on a converged spot due to a wavelength change in a light source within a range necessary for recording and/or reproducing of information means that when a light source wavelength λ changes by 1 nm, a wavefront aberration at a best image forming position before the wavelength change is regulated to be 0.02 λrms or less.

46. The optical pickup device of claim 37, wherein regulating a deteriorated spherical aberration due to a temperature change within a range necessary for recording and/or reproducing of information means that when a temperature changes by 30°C, a spherical aberration change amount of a wavefront aberration is regulated to be 0.04 λrms or less.

47. The optical pickup device of claim 37, wherein the following expression is satisfied when NA1 represents an image side numerical aperture of the light-converging optical element necessary for conducting recording and/or reproducing of information for the first optical information recording medium.

$$0.63 \leq NA1 \leq 0.67$$

48. The optical pickup device of claim 37, wherein the following expression is satisfied when $\Delta\lambda 1/\Delta T$ represents fluctuations of a wavelength of the first light source for temperature.

$$0.03\ nm \leq \Delta\lambda 1/\Delta T \leq 0.1\ nm$$

49. A light converging optical element for use in the optical pickup apparatus described in claim 1.

50. A light converging optical element for use in the optical pickup apparatus described in claim 37.

51. A correcting element for use in the optical pickup apparatus described in claim 1.

52. A correcting element for use in the optical pickup apparatus described in claim 37.